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HIGHLIGHTS

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* HUMAN ENGINEERING IN U. S. MISSILE PROGRAMS

A study team from Stanford Research Institute, Menlo Park, Calif. has warned the Air Force that human error has been causing from one-fifth to one-half of all missile system malfunctions -- including a large share of those blamed on such things as "faulty design".

The conclusion was drawn from an analysis of 4,248 malfunction reports covering the Atlas, Bomarc, Goose, Hound Dog, Mace, Matador, Titan and Snark programs, and Nose Cone Systems for Atlas and Thor missiles.

An almost complete breakdown of the Air Force failure reporting system is demonstrated by the Stanford study. Although human error is considered to be the largest single identifiable cause of missile malfunctions, this is not reflected in required reports.

"There is evidence to support the conclusion," the study declares, "that many human-initiated malfunctions are otherwise reported in order to avoid any implication of 'guilt' on the part of reporting personnel."

In one missile system, not identified, 1,391 malfunctions were reported. The records show 3 labeled as human errors. The Stanford study indicates that the correct total was at least 322.

In another system there were 977 reported malfunctions -- none of which were reported as human error. The study says that the true figure was 193.

Reliability and design personnel often have no knowledge of the true cause of missile malfunctions, the study suggests. In one R&D program several successful launches had been experienced using the same crew and equipment. But, the next time a technician connected a plug into the wrong one of two adjacent, identical receptacles. This error resulted in a "scrubbed" launch and a damaged missile.

"An examination of reports concerning this major failure," the study states, "revealed no indication of this sequence of events. Furthermore, interviews with reliability and design personnel revealed that even informal knowledge of this sequence of events had not been made available to them."

The study group concludes that present practices for collecting malfunction data are "highly inadequate" for identifying human error problems and particularly for originating corrective actions. A major revision of present practices and initiation of a human engineering testing and malfunction data collection system has been recommended. This would require the identification of the specific operation during which a malfunction is discovered and encourage the systematic collection of data concerning human-initiated malfunctions, even where no equipment breakdown is involved.

* LUNAR AND INTERPLANETARY PROGRAMS

The Jet Propulsion Laboratory, National Aeronautics and Space Administration, Pasadena, Calif. plans to spend approximately $50 million this fiscal year on lunar and planetary programs. Approximately 65 percent is under industrial contract, with indications that this proportion will increase in the next fiscal year.

Here is a summary of JPL plans in these fields as outlined to industry during the week:

ø Lunar Programs consist of three major projects, Ranger, Surveyor and Prospector, the latter two still in the study stage.

✓ Ranger will include five flights of a JPL designed spacecraft launched by Atlas Agena B vehicles leading to rough 200-300 mile-per-hour landings on the moon. (For likely launch dates see Washington SCIENCE TRENDS, Sept. 19, 1960.)

✓ Surveyor project will use Atlas Centaur vehicles, incorporating a hydrogen-fueled upper stage. A one-ton spacecraft will be employed to place 100 pounds of instruments in a "soft" or controlled lunar landing.

✓ Prospector project will probably use Saturn launching vehicles now under development since these are expected to be capable of accelerating payloads on the order of several tons to lunar transfer speeds. Possible missions are mobile or roving experiments on the moon and possible return of lunar material samples to the earth.

ø Planetary Programs have as a 1970 goal spacecraft capable of being put in orbit and landing on the surfaces of Mars and Venus and initial efforts toward probing Mercury and Jupiter as well as interplanetary probes. Interplanetary spacecraft using Centaur launch vehicles will be called Mariner, and those using the Saturn booster will be called Voyager.

✓ Mariner first mission is to be a Venus fly-by in 1962 to provide scientific measurements of Venus and a developmental test of the spacecraft and its scientific instruments. Second mission is a deep space probe later in 1962 with a nearly identical spacecraft on a similar trajectory. Same combination, with some refinements and instrument changes may be used for Venus in 1964 and possibly 1965. First Mariner launching for Mars is scheduled for 1963 as a developmental mission to be followed by a 1964 attempt to include some form of earth-return orbit.

✓ Voyager spacecraft will initially be an extension of Mariner with the additional injected weight available being used primarily for a retro-propulsion and terminal guidance system for a planetary orbit. Developmental missions to Venus will be conducted in 1965. Later Saturn C-2 booster vehicles would be used for such missions as a Mercury or Jupiter fly-by in 1970.

ø Scientific Objectives

Lunar program objectives include measurement of surface texture and hardness; temperature, temperature gradients and thermal conductivity; measurements of density, electrical parameters such as conductivity and permeability; nature and magnitude of the moon's magnetic field, if any; determination of the level of seismic activity and the use of geophysical methods to determine internal structure. Chemical and mineral analyses will be used to determine composition of surface and subsurface; any lunar atmosphere will be analyzed and organic molecules will be isolated and analyzed in the search for pre-life and sub-life forms.

(continued)

ø Scientific Objectives (continued)

Planetary programs will begin with near-misses of the planets, and planetary orbiters directed toward further knowledge of surface and atmospheric characteristics. An active radar may be included in the Venus orbiter for mapping the surface, since the planet's cloud cover appears to be opaque to visual systems. A Mars orbiter will emphasize surface photography, with the portion of the spectrum to be covered depending on results obtained by spectrophotometers carried aboard earlier Mars near-misses.

Mars landing spacecraft would probably have TV reading microscopes working in the ultraviolet and near ultraviolet region as well as systems for culturing microorganisms and measuring changes in the culture medium. Panoramic TV viewer would be highly important as would collection and examination of dust in the atmosphere.

Early shots toward Mercury would probably be devoted to photographing the surface and trajectory observation for determination of the planet mass and mass distribution. First Jupiter spacecraft will measure any radiation belt and magnetic field with a complete spectrum of field and particle detecting devices. Detailed spectrophotometric scans will be taken of such unusual regions of Jupiter as its "red spot". High resolution temperature mapping will be attempted, as will radar probing of the atmosphere. A spectrophotometric experiment designed to investigate the occurrence of simple organic molecules will be carried out since the atmosphere of Jupiter may be similar to that of the "early" earth. Photographs of the surfaces of the four large satellites of Jupiter are also of interest for later exploration.

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* DOING BUSINESS WITH JPL

Here's what JPL advises for organizations interested in preparing proposals for participation in the above programs:

"Your organization's knowledge and review of the scientific and technological aspects of the Laboratory's Lunar and Planetary programs may, from time to time, inspire ideas for possible solutions to many of the technical problems that will be encountered. Similarly, it is to JPL's interests to encourage and to receive unsolicited proposals.

"Recognizing the time, effort, and expense involved in preparing a formal proposal which might be unsupportable by the Laboratory, it is suggested that, should you be interested in such a submittal, a preliminary proposal be prepared which would comprise only one or two pages of material outlining the basic concept of the idea to be presented. An evaluation of this material by JPL scientific and technical personnel will determine the advisability of further development effort on your part. To attract the technical interest of the Laboratory, your suggestion should offer an advancement in the state of the art or improvements to the conventional technical approaches to problem solutions.

"Should the above information be of interest to your organization, proposals may be submitted to Mr. Dave Ireland at the Laboratory with the understanding that, without mutual interest, neither JPL nor yourselves are in any manner obligated to pursue the matter."

PLEASE NOTE: The latest JPL organization chart and a directory of JPL procurement officials are included as a supplement to this week's edition of Washington SCIENCE TRENDS.

* PROJECT VELA

The Vela research program aimed at solution of technical problems connected with the nuclear test ban continues to move into the operational hardware stage. (For details of this multimillion dollar project see Washington SCIENCE TRENDS, June 27, 1960.)

ø Vela Sierra -- is the program aimed at ground-based detection of nuclear detonations in space. Details are now available on the prototype detection station installed at Los Alamos by Edgerton, Germeshausen and Grier, Inc. Major purpose is the determination of whether "false alarms" of nuclear detonations can be triggered by lightning. In mid-November the Los Alamos station and a duplicate will be installed at Fairbanks, Alaska and Thule, Greenland for investigations into effects of particles from the Van Allen radiation belts and outer space.

The system uses a narrow band filter and optical detector mounted behind a wide angle lens to detect visible fluorescence in the upper atmosphere created by thermal radiation from a nuclear explosion. It is expected to be capable of detecting a one-megaton explosion at a distance of at least two million miles in daylight. Because of horizon shadows and cloud effects a number of such stations may be required.

The detection method resulted from an analysis of atmospheric radiation data obtained in high altitude nuclear tests in the Pacific in the summer of 1958. Data revealed that, for a bomb exploded in outer space, the thermal radiation lying in the soft X-ray region becomes absorbed in a fairly narrow portion of the atmosphere at about 50-miles altitude. It then, according to Los Alamos researchers, becomes essentially converted to nitrogen and oxygen fluorescence radiation.

Another system, proposed by R. Latter of the Rand Corporation, is concerned with the direct observation of light from the expanding particles of a bomb. Direct optical detectors are mounted behind telescopic lenses. It is hoped that this system will be capable of detecting a one-kiloton blast to a distance of 60,000 miles by day and 180,000 miles by night.

ø Vela Hotel -- is the program aimed at developing methods for remote detection of nuclear explosions in space. Primary emphasis is on satellite and missile instrumentation which can aid in distinguishing between background radiations and those emitted by such explosions. Los Alamos is concentrating on measurements of burst duration and energies of X-rays from the sun. The shortest burst of X-rays ever measured from the sun lasted about 18 seconds, while X-rays from nuclear explosions are emitted in a microsecond or less. According to H. Argo of Los Alamos, unless the sun's X-rays are found to come in these short bursts too, it will be possible to develop instruments that can distinguish weapon X-rays from natural ones.

Program includes: three flights aboard a Journeyman B or Blue Scout, Jr. four-stage solid propellant research rocket carrying electrostatic analyzers and scintillation detectors; Three Atlas pods, riding piggyback, and carrying instrumentation for measurement of protons and electrons; X-ray detectors aboard Ranger lunar missions to measure short-duration bursts from the sun; Electrostatic analyzers aboard the Project Mariner Mars/Venus launchings, aimed at information about solar "winds"; Two flights aboard 609A rockets carrying a gamma ray "phoswich" or scintillation gamma ray counter neutron counters, a proton telescope and ion probes; Balloon flights carrying a 150-pound package containing 12 scintillation X-ray detectors to altitudes near 120,000 feet. Los Alamos is also working on the development of a large open electron multiplier tube rugged enough to withstand rocket flight and efficient enough to detect X-rays in energy regions as low as 100 volts. A Nike Cajun rocket will be used for flight tests.

RESEARCH CHECKLIST

□ EVALUATING ARMOR PLATE: Army studies indicate that a so-called "circular patch" test can be used to evaluate armor steel according to susceptibility to cracking when welded under various degrees of restraint. Such a test is required because even when armor plate meets all the control tests of the materials specification there can still be a wide variance in performance during welding. As a result fabricators can generally detect sensitivity to weld cracks only after actual use in production of vehicles. The "circular patch" test studied by the Army is similar to that used by the Navy's Bureau of Ships for the qualification of electrodes.

(Details available through military channels or at $1 from OTS, U. S. Department of Commerce, Washington 25, D. C. Ask for Watertown Arsenal Technical Report 710/1075.)

□ NEW SOIL PSYCHROMETER: Agriculture Department researchers have designed a new instrument said to be capable of measuring differences in relative humidity as small as 1/2000 of 1 percent for basic research on soil moisture. The device, a type of wet-bulk thermometer, is known as a psychrometer.

(R&D by L. A. Richards and G. Ogata, U. S. Salinity Laboratory, U. S. Department of Agriculture, Riverside, Calif.)

□ INFLATABLE RE-ENTRY GLIDERS: Studies by the National Aeronautics and Space Administration indicate that inflatable re-entry gliders appear to be feasible in space applications, and could be constructed from high-temperature flexible materials now available. Among the most attractive features of such a system are foldability, low landing speeds, and reduced weight penalties.

(Technical details available. Write National Aeronautics and Space Administration, Attn: CODE BID, Washington 25, D. C. for NASA Technical Note D-538, A Study of the Feasibility of Inflatable Re-entry Gliders.)

□ HIGH RESOLUTION CAMERA: The National Bureau of Standards has developed a research camera said to be capable of projecting a parallel line pattern of 50,000 lines per inch -- a step toward a standard method for determining the resolving power of photographic materials. Optical system is essentially a fine apochromatic microscope system operated in reverse to make an extremely small image of a large chart. The camera, and associated methods, are not recommended for routine microcopying because of the difficulty in focusing, the problem of keeping dust from the field, the long exposures involved, and the difficulty of viewing the copy.

(For further details write National Bureau of Standards, Office of Technical Information, Washington 25, D. C. regarding High Resolution Camera.)

□ RADAR WEATHER RECONNAISSANCE: Research sponsored by the Air Force has resulted in development of a technique said to make possible radar measurements of air turbulence and wind velocity in storm areas. Statistical methods developed at Cornell Aeronautical Laboratory, Buffalo, N.Y. are used to extract such data from Doppler radar return signals of storm targets. Partial verification of the meteorological data extraction technique is said to have been obtained for snow and rain conditions with a standard low-power CW Doppler unit operating at 10,000 megacycles.

PUBLICATION CHECKLIST

- ☐ SHIPBOARD ELECTRONIC EQUIPMENT, a booklet prepared for Navy personnel and designed to provide persons who are not electronic specialists with an idea of the fundamental concepts of major electronic equipment for communications, radar, sonar and navigation aids. 181 Pages. $1.25 (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for Pub. D 208.11/2: El 2/4.)

- ☐ RADIATION AND CONTAMINATION CONTROL, a Defense Department publication presenting detailed information on the biological effects of radiation, radiation phenomenology, radiation instruments and dosimeters, health physics data, and maximum permissible limits of radiation. 154 Pages. $1. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for Pub. No. D 211.6/2 R 11/v.3.)

- ☐ DESIGNING MINE OPENINGS, a summary of new theories for designing mine openings and tunnels in rock. Of particular value to mining and civil engineers. 30 Cents. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for U. S. Bureau of Mines Bulletin No. 587.)

- ☐ TEACHING MACHINES, a compilation of major papers in the field of such machines and programmed learning. Some of the material is published for the first time. 736 Pages. $7.50 (Write Department of Audio-Visual Instruction, National Education Association, 1201 16th St., N.W., Washington 6, D. C. for Teaching Machines and Programmed Learning.)

- ☐ BERYLLIUM, an extensive survey of recent literature on this and related subjects as prepared by Lockheed Missile and Space Division. This supplement to a previous work covers information available as of early 1960. 59 Pages. (Available through military channels or at $1.50 from OTS, U. S. Department of Commerce, Washington 25, D. C. Ask for PB 161 812.)

- ☐ UNDERWATER EXPLOSIVES, this 1956 Defense Department publication, now available generally, describes techniques for use of explosives and other demolition material in underwater salvage activities, harbor clearance and related topics. 106 Pages. 70 Cents. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for Pub. No. D 217.12:2081.)

- ☐ FEDERAL STATISTICAL DIRECTORY, lists names, office addresses and telephone numbers of U. S. Government statistical personnel. 198 Pages. 55 Cents. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for Pub. No. Pr 34.111:960.)

- ☐ CYLINDRICAL SANDWICH CONSTRUCTION DESIGN, a compilation of technical papers representing efforts to develop design data which can be applied to cylindrical sandwich construction. Experimental data on flat and curved sandwich sections are furnished. (Available through military channels or at $4 from OTS, U. S. Department of Commerce, Washington 25, D. C. Ask for WADD Technical Report No. 60-133.)

- ☐ NITROPARAFFIN RESEARCH, a series of research reports which includes a comprehensive study of the sensitivity characteristics of nitromethane, which has received considerable attention as a rocket fuel and as a commercial solvent. (Available for inspection at U. S. Bureau of Mines Libraries, Washington D. C. and Pittsburgh, Pa.)

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Commodity Buying Assignment

L. A. O'Hearn, Supervisor
Ext. 1836, Bldg. 126

Bennett, J., Ext. 615
- Drafting equipment
- Office furniture & equipment
- Rental equipment
- Rubber products
- Seals, gaskets, O rings

Bruce, J., Ext. 617
- Advertising
- Graphic arts
- Library services
- Printed forms
- Publications & books

Hansen, L., Ext. 1817
- Chemicals
- Explosives
- Industrial gases
- Laboratory equipment & supplies

Montgomery, J., Ext. 696
- Bearings, gears & pulleys
- Electrical supplies
- Machinery & equipment
- Motors
- Pumps
- Tanks & pressure vessels

Schwartz, R., Ext. 1842
- Pipe & pipe fittings
- Plumbing
- Valves
- Wire & cable

Sherwood, D., Ext. 694
- Batteries
- Instrumentation & controls (nonelectric)
- Medical supplies
- Optical equipment
- Photographic equipment & supplies
- Welding equipment & supplies

Stephenson, J., Ext. 1838
- Abrasives, solid & coated
- Coolants
- Fuels, lubricants
- Hand tools
- Inspection gages & equipment
- Perishable tools
- Shop supplies

Wells, R., Ext. 648
- Office & art supplies
- Paper & stationery

J. Whiteley, Supervisor
Ext. 1566, Bldg. 125/160

Kirby, R.
- Electronics training

Puelle, W., Ext. 1184
- Electronic equipment
- Systems & instrumentation

Haire, G., Ext. 1557

Howard, R., Ext. 1237

Vickers, P., Ext. 1235
- Electronic components
- Accessories & small equipment

D. Malcomson, Supervisor
Ext. 1858, Trailer 33 & 45

Bernhisel, J., Ext. 2173

Boucher, H., Ext. 2177

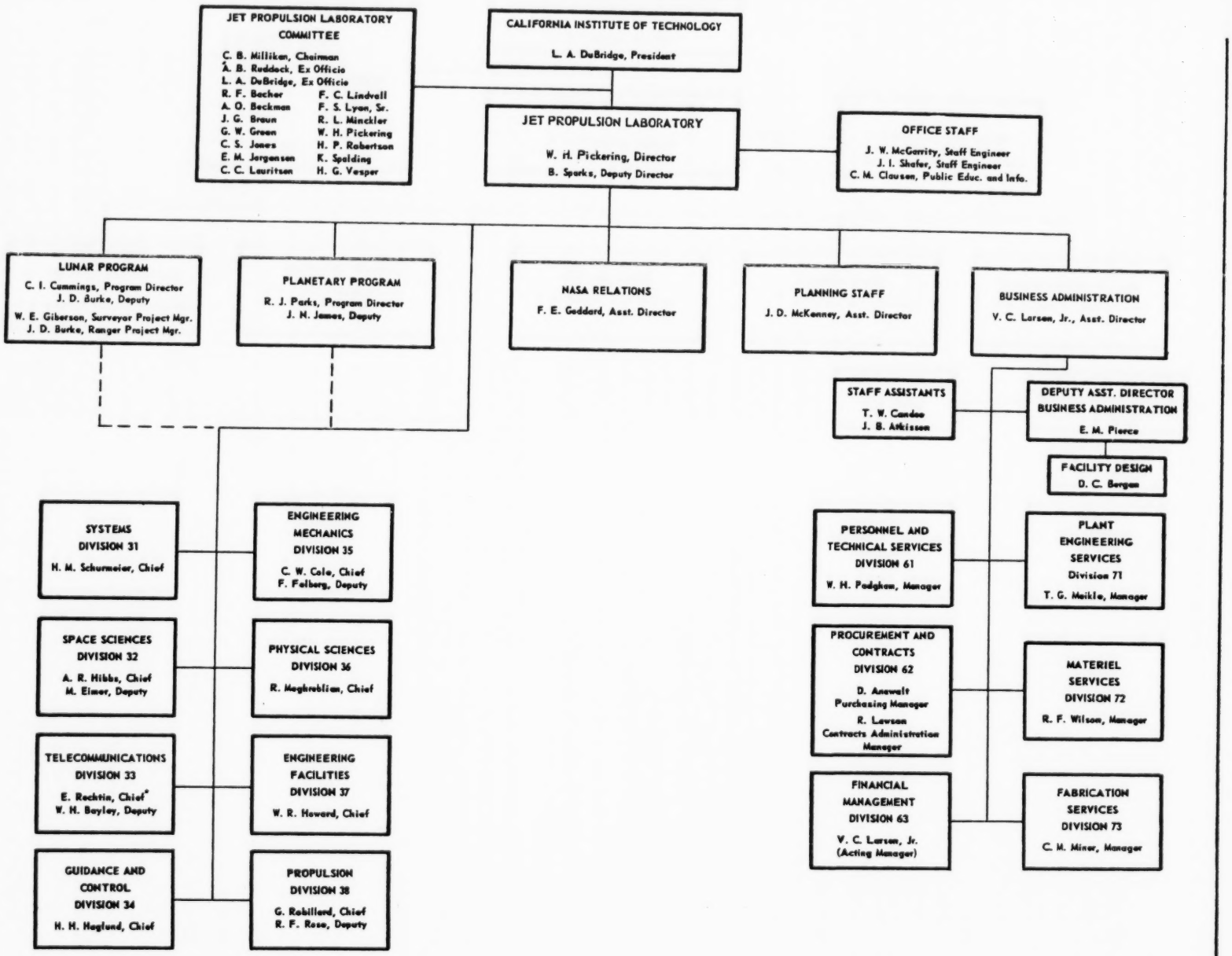
Steadman, L., Ext. 2175

White, L., Ext. 2171
- Outside fabrication, machining & processing

Nickbarg, R., Ext. 2161
- Castings, forgings, metals
- Consulting studies
- Engineering studies
- Plastics

Forchini, J., Ext. 2165
- AN,NAS fittings
- Automobile equipment & supplies
- Safety equipment & supplies
- Threaded fasteners

Tembrock, G., Ext. 2167
- Builders hardware
- Building materials
- Construction
- Lumber
- Paint
- Glass



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